

Claims:

1. An apparatus for generating charge from a light pulse, comprising:
 - a substrate;
 - a light sensor having an active region for generating an electric charge in response to a light pulse; and
 - a drift region, formed in said substrate, for receiving said electric charge from said light sensor and producing a spatial charge distribution therein in response to an electric field, said drift region having an outer edge and an inner edge, where a volume of said drift region decreases from said outer edge to said inner edge.
2. The apparatus of claim 1, wherein said drift region is an elliptical drift region and said active region of said light sensor is an elliptical active region circumscribing said elliptical drift region.
3. The apparatus of claim 2, further comprising:
 - a plurality of concentric elliptical gates disposed on said substrate above said elliptical drift region.
4. The apparatus of claim 3, further comprising:
 - bias circuitry for applying a voltage across said plurality of concentric elliptical gates to generate said electric field.
5. The apparatus of claim 1, wherein said drift region is a trapezoidal drift region.
6. The apparatus of claim 5, further comprising:
 - a plurality of gates disposed on said substrate above said trapezoidal drift region.
7. The apparatus of claim 6, further comprising:

bias circuitry for applying a voltage across said plurality of gates to establish said electric field.

8. The apparatus of claim 1, further comprising:

a readout sensor, formed in said substrate proximate said inner edge, for providing said spatial charge distribution as output.

9. The apparatus of claim 8, further comprising:

readout circuitry for reading out said spatial charge distribution using said readout sensor.

10. The apparatus of claim 1, further comprising:

one or more microlenses disposed over said active region of said light sensor.

11. A method of generating charge from a light pulse, comprising:

generating an electric charge in response to a light pulse;

injecting said electric charge into a drift region formed in a substrate, said drift region having an outer edge and an inner edge, where a volume of said drift region decreases from said outer edge to said inner edge; and

applying an electric field to said drift region to produce a spatial charge distribution therein.

12. The method of claim 11, wherein said drift region is an elliptical drift region.

13. The method of claim 12, wherein said step of applying an electric field comprises:

applying a voltage potential across a plurality of concentric elliptical gates disposed on said substrate above said elliptical drift region.

14. The method of claim 11, wherein said drift region is a trapezoidal drift region.

15. The method of claim 14, wherein said step of applying an electric field comprises:

applying a voltage potential across a plurality of spaced apart gates disposed on said substrate above said trapezoidal drift region.

16. The method of claim 11, further comprising:

recovering said spatial charge distribution from said drift region using a readout sensor.

17. An apparatus for resolving time-of-arrival of a light pulse, comprising:

a substrate;

a light sensor having an active region for generating an electric charge from a light pulse;

a drift region, formed in said substrate, for receiving said electric charge and producing a spatial charge distribution therein in response to an electric field; and

a control circuit for determining a time-of-arrival of said light pulse in response to a position of said spatial charge distribution within said drift region.

18. The apparatus of claim 17, wherein said drift region comprises an outer edge and an inner edge, and wherein a volume of said drift region decreases from said outer edge to said inner edge.

19. The apparatus of claim 18, wherein said drift region is an elliptical drift region and said active region of said light sensor is an elliptical active region circumscribing said elliptical drift region.

20. The apparatus of claim 19, further comprising:

a plurality of concentric elliptical gates disposed on said substrate above said elliptical drift region.

21. The apparatus of claim 19, wherein said drift region is a trapezoidal drift region.

22. The apparatus of claim 21, further comprising:
a plurality of gates disposed on said substrate above said trapezoidal drift region.
23. The apparatus of claim 19, further comprising:
a readout sensor, formed in said substrate proximate said inner edge, for providing said spatial charge distribution as output.
24. The apparatus of claim 17, further comprising:
an analog storage device for storing said spatial charge distribution.
25. The apparatus of claim 24, wherein said analog storage device comprises a charge-coupled device (CCD) register having a plurality of bins.
26. The apparatus of claim 17, wherein said drift region comprises an n-buried channel or a p-buried channel formed in said substrate.
27. A method for resolving time-of-arrival of a light pulse, comprising:
generating an electric charge from a light pulse;
injecting said electric charge into a drift region formed in a substrate;
applying an electric field to said drift region to produce a spatial charge distribution therein; and
determining a time-of-arrival of said light pulse in response to a position of said spatial charge distribution within said drift region.